VITALIZING THE ELEMENTARY SCIENCE CURRICULUM

ELIZABETH SPARROW KISER

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VITALIZING THE ELEMENTARY SCIENCE CURRICULUM

ELIZABETH SPARROW KISER

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requirements for the degree of Master
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In the following pages a plan for the enrichment of the elementary school science curriculum is developed.

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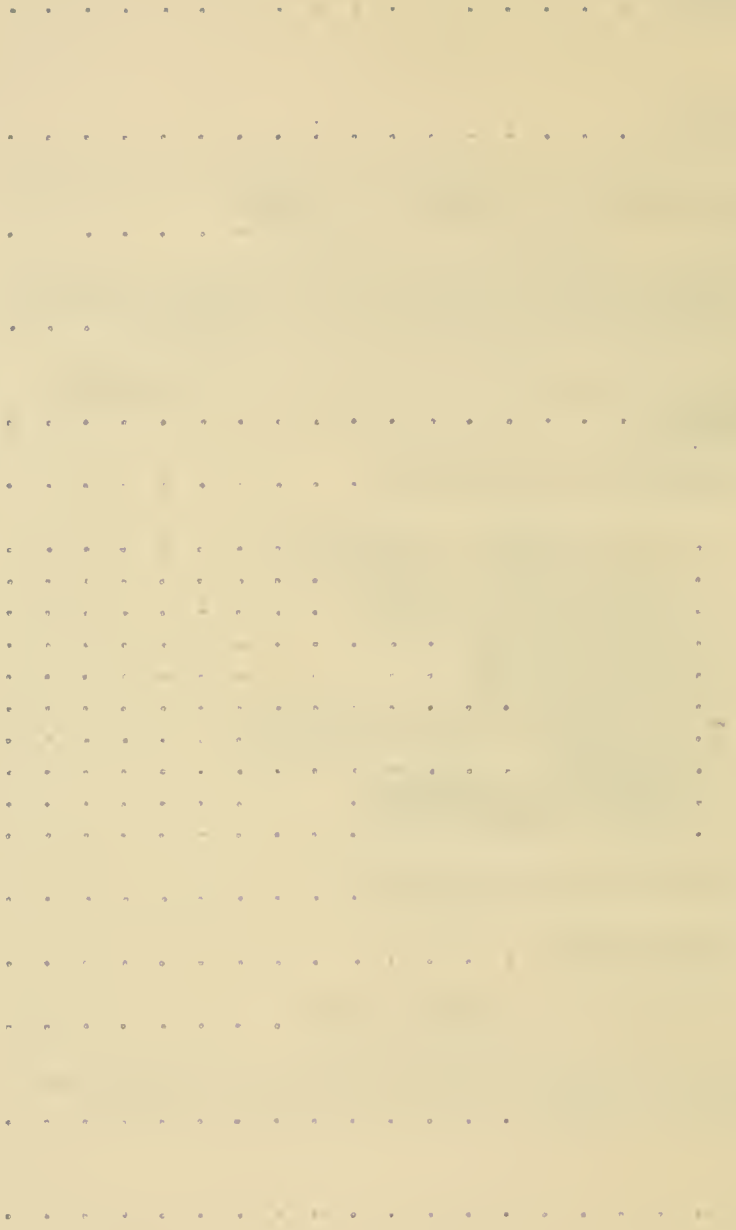

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SECTION 1

THE PROBLEM

The purpose of this study is to suggest materials and methods of instruction for the enrichment of the Science Program in the Elementary schools of Florida.

SPECIFIC PROBLEMS

A. Materials of Instruction

1. Developing ways and means of utilizing community resources in the Elementary School Science Program.
2. Making a study of scientific community problems.
3. Devising a list of inexpensive equipment and apparatus for use in teaching the elementary school science program.
4. Making use of Audio-Visual Aids in teaching science in the elementary school.

B. Methods of Instruction

1. A review of effective methods, procedures, and techniques of enriching science in the elementary schools.

DEFINITION OF TERMS

1. "Vitalizing", means to make more complete and efficient with respect to elementary school science teaching.

2. "Need", is used to mean something which is of vital importance to the development of the child through elementary school science.
3. "Scope", refers to breadth or range of work.
4. "Processes", are a series of experiences within a field of interest. For example, a child brings a specimen of plant life to the classroom. He is excited over finding this strange and new plant. A study of the reason for the plant being in the child's environment and the life history of the plant's existence evolves a process of experience within the child's life.
5. "Documentary materials", are all written materials except maps, charts, photographs or other such visual aids which can be utilized for teaching.
6. "Audio-Visual Aids", are materials which are used for instruction and which appeal to the senses, especially through the eyes and ears.
7. "Resource Visitors", are people who are experts in their field of accomplishment and who show a willingness to share ideas helpful to students for learning about these areas of achievement.
8. "Interviews", are conferences held with people who conduct a business. This is done at the place of business and is conducted on a question and answer basis.

9. "Field Trips", are short or long journeys taken for the purpose of studying phenomena of nature.

10. "Surveys", are studies made of communities for the purpose of gaining profitable information concerning problems of immediate or future settlement.

11. "Extended Field Studies", are studies made from trips taken for the purpose of surveys to study problems of interest to the group. These may be over short or long periods of time and nearby or long distances. The time is spent living together while studying.

12. "Camping", is group living for the purpose of studying nature. This is used extensively by 4-H Club groups, Campfire Girls, Girl Scouts, Boy Scouts, Future Farmers of America and other such groups.

13. "Service Projects", are group activities cooperative with community needs for the purpose of civic or social value.

14. "Work Experiences", are those activities which are done by the younger citizens for monetary gain or for instructional enlightenment. Delivery of papers, clerk in stores, soda fountain service, home help are some examples of these kinds of experiences.

DELIMITATIONS

This thesis is limited to a study of and suggestions for the improvement of the science curriculum in the elementary schools.

BASIC ASSUMPTIONS

1. There are enough natural materials within the environment of the child to enable the science curriculum to be enriched through the correlation of experiences with the basic knowledge achieved through the study of elementary school science textbooks.
2. All normal children are interested in their natural environment, and the interest of most children can be obtained through the study of science.
3. The development of ways and means of utilizing community resources in the elementary science program will cause the program to be enriched.
4. The elementary school science program will be enriched by devising a list of inexpensive equipment and apparatus for experimental use.
5. A review of the literature relating to the elementary field of science will provide feasible materials and methods which can be constructively used in the teaching of science in the elemtnary school.

NEED FOR STUDY

We are living in an age of science. The recent discovery of the use of atomic energy is causing a great deal of international distress. The proper use of this energy will depend upon the scientific education of the child. There are many other scientific understandings and discoveries, if brought within the young child's life, will enrich his social, economic and religious understanding.

To the young child natural science is life in a full, rich, deep sense. Many secrets withheld from him by his parents are discovered through observing his natural environment. The answers to questions concerning origin of life, sex, health, obtaining of food, and social behavior can be taught through his natural environment, if this environment is brought into the classroom to be studied.

The need for this kind of science is great. The child is a natural observer. Many things are misunderstood. This is why a scientific study of his environment is important for the child and the development of a well informed future generation.

A greater need than ever before is arising for the teaching of social interrelationship. The basic underlying knowledge may be achieved through observing, in the natural environments, the habits and life cycle of plants, insects, birds, snakes and mammals.

The child has a feeling of creativeness when he is with nature. This sense of being a part of God's creation should not be lost when he enters the classroom. The interrelationship between a child and his environment is no point to be forgotten, even in this atomic age. He should know that man is powerful enough to be master over his environment. Early in life he should be taught concerning the things which harm the human race and how to combat the enemies of his life. He should also learn from his contacts with his environment that some things are by nature beneficial to man. Examples of these revelations are to be found in his natural environment. Long hard rains erode the soil. Fierce winds destroy crops, trees, houses, and sometimes cost people their lives. Poisonous snakes are to be learned and proper care taken to avoid their harmful bite. Insects which are destructive should be learned and some methods of control be studied. Some plants are harmful to man's health. These should be studied and properly identified. Some of the natural world is of benefit to man. Plants, animals, insects and life in general may be beneficial to man if he knows the ways of making use of these natural phenomena. How to conserve natural resources should be studied.

There is a need for the correlation of science with other subjects. This can be done through reading, spelling, writing, mathematics, social studies, English, art and music

in connection with natural science.

There is a need for the child to feel that a richer, fuller life can be achieved through adventures in science.

INCIDENCE OF THE PROBLEM

Interest in this field developed through teaching children who showed interests in the natural phenomena of nature. Many children continued to bring specimens of their own discovery to the classroom for investigation and study.

While study was being made of these specimens a handicap of proper materials, including a suitable bibliography for elementary school use, was discovered.

Since keen interest and a desire for knowledge in science was encountered through contact with children, a need for correlation of science with other subjects was encountered.

Techniques for the teaching of science are a serious need for elementary school teaching.

RELATED LITERATURE

1. A Brief Course In The History of Education by Paul Monroe is especially good in the development of educational trends from the early days of prehistoric times up to and including the present day practices.
2. The Growth of Biology by William A. Lacy is a source from which to secure information concerning important men who have contributed toward the development of "pure science" which is a basis for the formulation of

educational practices in science teaching.

3. Science Teaching at Junior and Senior High School Levels by George W. Hunters is a book which gives the developmental techniques for science teaching.
4. Science in the Elementary School by W. C. Croxton is outstanding in its treatment on elementary school science, educational techniques and practices.
5. School and Community by Edward G. Olsen is a treatment of techniques of approach used in tying school procedures with community resources. This modern treatment is a source of information which reveals present practices in modern aggressive schools. Much use was made of Olsen's book in developing techniques for enriching the science curriculum.
6. "A Guide To Teaching Science in the Elementary School", Bulletin No. 7, State Department of Education, Tallahassee, Florida, December, 1947, is a bulletin which relates scope, materials, and practices, for the state of Florida. This bulletin is one of the most practical sources found for teachers in elementary school science. Every teacher is handicapped without a copy of this bulletin.
7. The Child and His Curriculum by J. Murray Lee and Doris May is a book which has discussions on units

and projects as techniques of study used in the classroom.

8. Science For The Elementary School Teacher by Gerald S. Craig is a source of modern trends and information of concrete nature for use in teaching of science. This book is good to have in the classroom as a source reference.
9. Natural Science Through the Seasons by J. A. Partridge treats science materials in regard to seasonal interests. This book should be available to all classroom teachers.

PROCEDURE IN COLLECTING DATA

In collecting and organizing data for this thesis the following sources have proven to be of vital importance:

1. Research in the literature dealing with the elementary school science.
2. Research in community resources available to pupils of Florida.
3. Conferences with elementary school science teachers.
4. Conferences with college teachers.
5. Graduate courses taken in science, education, sociology, and philosophy.
6. Experiences in elementary school science teaching.

PROCEDURE IN TREATING DATA

Materials used in this thesis are obtained from elemen-

tary school texts, college reference books, bulletins, pamphlets, and magazines. These sources provide a wealth of materials which need to be organized in usable form for the science program of the elementary school. A comparison of the elementary school science programs exercised by various elementary school teachers is helpful in enriching the science program in the elementary school. Careful observation and criticism of classroom science teaching provide effective suggestions for use in teaching science in the elementary school. Materials and procedures will be a result of the research in this field with special emphasis upon enrichment of the present program.

SECTION II

DEVELOPMENTAL TRENDS IN GENERAL EDUCATION AND THE TEACHING OF SCIENCE

Science education has developed much in the same way as general education for man. Primitive men had no highly developed technique as we have today, however, the aims embodied in their development were basically the same. They sought food, clothing, and shelter. The child learned by imitation for the purpose of helping his parents with the work to be done. The parents transmitted to their children the knowledge which they learned through experience, either from their lifetime or from their ancestors. Animism laid the foundation upon which man based the first standards of education. From these primitive peoples there evolved natural religion, early philosophy, and rudimentary sciences; and with the formation of these, written languages were invented and a special body of knowledge accessible to a few was developed. Along with this came the development of a special priesthood which was composed of a body of men which began to teach and impart knowledge. This body of men organized to teach prospective members of the priesthood which marks the beginning of the first school.

The second stage of educational development which marks the first educational stage in civilization is known

as oriental education. Two outstanding features of this era were the transition from the genetic organization to the political organization and from spoken language to written language and literature. The political organization of society is one in which the individual is recognized in education and society. Society became conscious of the past and then aimed toward preservation of knowledge as it was learned in the past. Formal education with these early peoples was aimed towards mastery of the languages, mastery of improved forms of conduct which was embodied in the literature, and towards the imposition of such standards of conduct upon all peoples. Finally the oriental or Chinese people put the control of their society into the hands of the people who had assimilated the literature and who understood the culture as it had developed up to this time. This organization of Chinese society became static and lacked progressivism.

The development of Greek culture and their educational philosophy has served as a standard from which our present day standards and principles has gained many valuable and workable ideas. The Greeks first worked out the various aspects of personality and strove in their education to improve the personality of the individual. The educational system developed along with, and grew out of, an historical

development over a period of years. During the Homeric period the social ideals were embodied in the warriors and their councilor. The Spartans continued this emphasis in social ideals. The entire society was to have education of physical nature aiming towards protection of their peoples. In Athens the individual was given more emphasis;

> "the state determined the standards, but the family provided the education. Schools of two types, one for music and literature, the other for gymnastics were established. After Ionian Greece was brought into close contact with other peoples, the old conservative educational ideals and practices were replaced by those which gave greater scope to the individual. The sophists or teachers were instrumental in introducing the new educational practices. The Greek philosophers, especially Socrates, Plato, and Aristotle, attempted to harmonize this conflict between the old institutional education and the new individualistic education. The result was one which gave a statement of the problems of education which were much the same as those of the present time." [1]

The effect of problems of education, while the same as those of today brought no effect as to organization of a system of workable nature. The Roman empire checked the individualistic side of development while Christianity brought impetus to the normal side of educational development. Before these two checks in development arose, the Greek education became universal in nature.

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1. Paul Monroe, A Brief Course In The History of Education, (New York: MacMillan Company, 1920), pp. 78-79

The Romans brought into the evolution of education a practical angle of institutions as a means for realizing ideals of special progress. "The home was the chief educational institution, and imitation was the chief method, while biography and the practical processes of life were the chief educative means."[2] The Greek ideals appealed to the upper classes and left untouched the masses of people. The great achievement of Latin literature were products of the very earliest portion of this period when the Roman genius had lost none of its virility and the Greek education had been adopted only to a slight extent. This imitation by the Romans of Greek education became artificial, and Roman education became very formal and unreal. Roman life tended to develop corruptness in it.

> "Government became despotic, the early individualism and virile character of the Romans were lost, and the dominant education ceased to have any vital connection with the life of the times. Consequently a new education that was furnished by the early Christian Church replaced the old. Roman education lost its social importance though its structure continued to persist even after the barbarians had seized control of the empire in the West." 3

During the middle ages Christian religion was the dominant educational influence. The acceptance of the Christian

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2. Ibid, p. 99
3. Loc. cit.

principles of love or charity made education have a different angle, one which could be achieved by all, regardless of class or social status in life. This gave the underprivileged classes an opportunity which had hitherto been unknown. At first the church was friendly to the classical literature of the Greeks, but later, due to secular development, it became unfriendly. Monasticism became the chief educational form. Social development was neglected for moral development. A chivalric form of education under the feudal system was elaborated upon. This organization trained the page and squire as preparation for knighthood. There was the guild school organization common to the individual groups in society.

> "After the close of the thirteenth century, the new individualistic interest found expression through the vernacular literatures, through commerce, through the new intellectual interests, through the influence of the Saracens and friars and through new types of schools. The tendency of these changes was to destroy the unity of thought so characteristic to Middle Ages." 4

The early part of the Middle Ages is known as the Dark Ages, because much of the literature of the former periods was destroyed. The exercise of copying manuscripts by the monks preserved what we now have from earlier time.

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4. Ibid. pp. 157-158

"The Renaissance, primarily a movement of individualism, stressed the quality of improving the latent qualities of the individual as a social asset in society. Two aims of developing personality were: 1. Using a variety of means of education besides literature, 2. The revival of Greek liberalism. The two aims were characteristic of the Renaissance period. Then there developed a dominant type of narrow individualism which dominated the broad type which was described above, and finally this emerged into a formal discipline of the individual to use of literature as a means of discipline, rather than education for morals. Erasmus was the most prominent of the Renaissance educational leaders. The German gymnasium, the English public school, the American colonial grammar school and college were all types of the narrow humanistic schools. In general the content of education was restricted to the Greek and Latin languages and literature. This purely formal type of education became identified with the liberal education and was the dominant type of education well into the nineteenth century. Any other type of education or practice of education was wholly subordinate to the narrow humanistic school and was of importance only as a germ of subsequent development." 5.

"The Reformation which was the Renaissance north of the Alps was directed towards reforms in society and in the church. It exalted the use of individual judgment." 6

This exaltation of individual judgment led to the separation within the church. The early Reformation period tended to emphasize reason, the right of private judgment, and the necessity of familiarity with original literature as a source of ideas. Because of the formation of many religious sects, educational influences emerged into a new formalism similar

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5. Ibid., p. 188
6. Ibid., p. 214

to the old scholasticism.

> "The chief results of the Reformation period were the transfer of the control of the school from the church to the state, the building up of the state system, and the development of the idea of universal education, based upon the idea of the necessity of reading the scriptures, catechisms, and other religious literature." 7

Martin Luther, a German, was the most prominent of these leaders or reformers.

> "His views were more broad than were the views of his followers. Melanchton put the views of Martin Luther into practical operation, and he is responsible for the training of teachers, the writing of texts, and the organization of the Saxony system. The Universities and humanistic schools, though nominally under state or independent organizations, were actually under the control of the Church. First in Germany, then in Holland, Scotland, New England and other Protestant states, public school systems were developed during the seventeenth century. To the Reformation, then, we owe our idea of universal elementary education and also the early realization of this idea." 8

> "The realistic movement was the development of the interest in nature found in the Renaissance of the fifteenth and sixteenth centuries. During the seventeenth century this interest received philosophical and scientific formulation. At this time modern philosophy and modern science began. Educationally, however, there were two stages which led up to the realistic movement. One stage was the Humanistic Realism or the study of classes for their content value. This was the continuation of the idea of a broad liberal education of the early Renaissance. The other stage was Socialism-Realism or immediate education for the practical duties and pleasures of life. Broad liberal education is best represented by Erasmus, Rabelais, and Hilton. Socialism-Realism held literary training in low esteem and exalted travel and direct contact with the world as the proper educa-

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7. Loc. cit.
8. Loc. cit.

> tional means. Montaine best expresses this point of view of education. Sense-realism was the beginning of the modern scientific movement in education, and Bacon first formulated the idea of science in education through realistic training. Comenius gave practical pedagogical embodiment to socialistic realism. The German real-schools and the English and American Academies were the institutional embodiment of these realistic ideas." 9

> "Socialistic changes during the sixteenth and seventeenth centuries destroyed the practical bearing of the narrow humanistic education. Social organizations desired the perpetuation of disciplinary conception. According to this view the value in education was achieved through the process of acquiring knowledge. The correct process or method of education would result in the development of the mental power which would be applicable to all subjects. Memory and reason, faculties of the mind, were to be trained in this manner." 10

This theory continues to survive after the modern ideas of psychology and science were born into our educational system. The great theoretical representative of this view was John Locke. He brought into view a physical and moral training, as well as intellectual. This view is one of the theories found in practice in many of our secondary and elementary schools today.

> "The dominance of arbitrary authority which was exercised by absolutism in government, orthodoxy in religion, traditional classicism and disciplinary conception in education produced during the eighteenth century a vehement and revolutionary reaction. The earlier aspects of these movements which were known as the Illumination or Enlightenment were largely intellectual and aristocratic. These movements included a rationalistic revolt against orthodox re-

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9. Ibid, p. 253
10. Ibid. pp. 270-271

> ligious views, an aristocratic revolt against absolutism in the church and state, and a revolt against puritanism in morals. These movements resulted in a skepticism in religion, a cynical formalism or polished immorality in conduct, and an aristocratic indifference to the rights and needs of the masses. The revolutionary tendency in the last half of the century (eighteenth) became known as the Naturalistic Movement. This tendency was emotional, rather than intellectual, democratic rather than aristocratic, and was directed toward social reform rather than towards class or individual aggrandizement. Voltaire was a leader in the Illumination or Enlightenment period; Rosseau was the leader in the Naturalistic movement." [11]

Rosseau contended that the child should be educated through natural development rather than by imposed knowledge from his elders and according to standards set up by an adult social order. Children are children and should be given a chance to develop according to and not against their wills. Not until the adolescent period should an attempt be made to establish life in accordance with society. "The immediate application of Rosseau's teachings was attempted by Basedow and the "philanthropinists". The successful use of this philosophy was made by Pestalozzi, Herbert, and Froebel." [12]

"The psychological tendency in education was a reduction in the naturalistic movement and an increase in the scientific principle and in practical classroom procedure."[13]

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11. Ibid. p. 301
12. Loc. cit.
13. Ibid., pp. 348-349

Today, in the twentieth century, there is a scientific tendency in education which embodies many phases. When we take a view of the systems of education, we are looking through a glass which depicts the philosophies and techniques and practices which began with primitive man and evolved in each era until we have just what is present today. We still have many schools which believe in strict discipline and indoctrination. The schools maintain that the educational policy of keeping the child in a straight row of seats and making him memorize the textbook without any actual experience of his learning should be the standard policy. On the other hand there are many schools and systems which believe in giving the child real life experiences to provide greater opportunities for growth. John Dewey, the modern American philosopher, would agree with this view, for teaching the child or having the child learn by experience is one of the major points in his philosophy. Pestalozzi, Herbert, and Froebel all had views which were in favor of giving the child an opportunity to really live in the classroom. The stand which John Dewey takes, that both science and morals can be joined together in their development in educational systems, is a point that many educators are accepting as a present standard to be used in all phases of

education.

Now that familiarity with general educational phases has been established, let us look at science education apart from other categories in education. The field of education has been slow to recognize the phase of science. Much of this failure has been due to the lack of knowledge of scientific truths which have not become a part of the average elementary school teacher's training. The present situation in science can best be understood if a view of the past movements in this field is afforded. Science seeks truths based upon actual experimentation and proof of discovery. Once a finding is made educators seek pedagogical organization for the benefit of enlightening mankind. In the elementary school phase of organization there has been a borrowing from the higher organizations such as the university, senior colleges, junior colleges, and secondary schools.

> "The first well-defined epoch of natural science was in the fourth century before Christ among the Greeks. Aristotle and Theophrastus were two master-minds. They were both original observers and methodical in their treatises on animals and plants. Aristotle was the greater intellect of the two. Their product has been undervalued by those modern writers who have possessed no first-hand knowledge of their works. This makes it necessary to correct many misconceptions. A reading of the Historia animalium shows that Aristotle was an original observer, contributing many positive observations to zoological science--while his theoretical considerations have become obsolete. Theophrastus was a scientific botanist studying plant structure, growth, and distribution. Ecology is often thought of as

> decidedly a recent subject, but Theophrastus did something in that line by observing association of plants in different habitats, swamps, fields, ponds. He founded botany as a science. He did not -- as often stated -- give chief attention to the medical properties of plants. Both Aristotle and Theophrastus made experimentation the basis of science." 14

> "During the Roman period of development Galen was the leading anatomist of his day and retained his primacy up to the time of Leonardo Da Vinci (1510) and Vesalius (1543). He is best known for his work on the brain, the spinal cord and the nerves. His conceptions of the nerves in relation to sensation and voluntary motion were essentially the modern ideas. Galen's experimental investigation of the spinal cord by sections at different levels and by half-sections was still more remarkable. It is quite modern in precision and completeness (Payne)' ". 15

According to Locy, Aristotle and Galen are the two most outstanding contributors towards scientific discovery in the field of biology until after the Renaissance.

> "The best minds of the Middle Ages were concerned with other matters, such as dialectics, metaphysics, ecclesiastical philosophy, while science was stigmatized as a product of pagan thought. The Christian Church acted as the foster-mother of culture and learning. Book multiplication was carried on in the scripteria of the monasteries; the collecting of books into libraries and reading by the educated were active. The method of reference to authority in matters of science and learning created an unprogressive attitude of mind against which a few more independent thinkers struggled. At intervals we encounter men of independent thinking, and in the twelfth century we get a glimmer of the scientific spirit in Adelard of Bath. The Saracens played a part in preserving and transmitting the manuscripts of classical antiquity, especially those on the science of nature and of medicine. They also founded great universities in Bagdad and Cordova where learning prospered, but they were not a creative people fitted to carry on investigation of natural phenomena. Two Arabian physicians Avicenna and Avelrroes, exhibited a spirit of inquiry and their writings had marked in-

14. William A. Locy, The Growth of Biology (New York: Henry Holt and Company, 1933), pp. 38.
15. Ibid, p. 67

fluence in the early founded universities of Western Europe." 16

> "The cyclopaedias of the thirteenth century helped spread knowledge regarding animals and plants. Albert the Great made Aristotle's philosophy of nature palatable to the Church, and Bartholomew came very near making natural history popular. These were preliminary steps to the liberation of natural history from the bonds of scholasticism. What was needed was that the phenomena of the material world should be separated from the mystical interpretations of philosophy. This step was taken in the following centuries and when once the material world, with its unlimited possibilities, was recognized as the proper field of investigation, the advancement of science received a new lease of life." 17

During the Middle Ages there was a mental laziness accompanied by a lack of originality and iniative on the part of science development. In the sixteenth century there was a reawakening of progress. Andreas Vesalius is known for achievement in anatomical structure. Vesalius wrote a book which laid the foundation for structural studies in biology. William Harvey, of the latter part of the sixteenth century and early part of the seventeenth, is known for his study and observation of the circulatory system of the blood of the human body. In the early seventeenth century Galileo is given credit for the invention of the microscope and the telescope which have been two practical tools for advancing the efficiency of laboratory discoveries to which scientific advancement of all phases has been greatly

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16. Ibid, p. 88
17. Locy, Op. cit. p. 88

benefitted. Following the discovery and invention mentioned above research work was done on micro-organisms. Kohn, Pasteur, Koch and Lister are outstanding in this field of achievement.

Outstanding men who have been responsible for discoveries in science beginning with the seventeenth century are: Sir Isaac Newton (17th century) who discovered the law of gravitation,[18] Robert Hooke (1665) discovered the cell, Leeunwenhoek (1674) discovered unicellular animals, Robert Brown (1833) discovered cell nucleus, Schleiden and Schwann (1838) formulated the cell theory, Purkinje (1846) gave protoplasm its name.[19] Gregory Mendel (1866) published work on chromosome theory of inheritance.[20]

Madam Marie Curie (1867-1934) was a Polish born French physical chemist who discovered radium. She was a forerunner of the study of atomic energy. Dr. J. R. Oppenheimer was chief among the "Atom-Bomb" engineers whose work was done in 1945.

The work of these and other scientists give educators the foundation for subject matter which makes possible the education of students in practical understandings of scien-

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18. Joseph Devlin, Webster's Complete Encyclopedia, (New York: World Publishing Company, 1946), p. 876
19. Robert W. Hagner, College Zoology (New York: The Macmillan Company, 1944) pp. 29, 37-38
20. Lawrence H. Snyder, The Principles of Heredity, (Boston: D. C. Heath and Company, 1946), p. 21

tific discoveries amd inventions. Science education which is based upon research has gone through many changes.

> "The real beginnings of science in education were fostered through the use of the inductive method suggested by Francis Bacon (1561-1626). Through his Advancement of Learning and Novuum Organum the real suggestion of science in education began". 21

Hunter gives credit to Comenius for the beginning of Visual Aids which are being used as a chief means of teaching science in the elementary school today. He stressed the use of objects as an aid to teaching children. If objects were unavailable his idea was to use pictures or models.

> "It was a slow but interesting evolution from the time of Comenius (1592-1670) through Rousseau (1712-1778), Basedow (1723-1790), Pestalozzi (1746-1827), and Froebel (1782-1852). In the work of each of these men we recognize the insistence on the use of natural objectives and of nature as a teacher. Particularly Rosseau and Pestalozzi were believers in the outdoors and in field excursions. Herbart (1776-1841), one of Pestalozzi's pupils, was a man who recognized what so many people forget today, that,without interest on the part of the child, work is impossible at any school level. 22

The beginning of modern science in education, according to Hunter in his book on Science Teaching, was done by Herbert Spencer in his essay "What Knowledge is of Most Worth". Herbert Spencer had five groups of activities which he stressed as being of importance in education --

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21. George W. Hunter, Science Teaching at Junior and Senior High School Levels, (New York, American Book Company, 1934), p. 16
22. Ibid, pp. 16-17

> "those leading to direct self-preservation; those which, by securing the necessities of life, lead indirectly to self-preservation; those which have to do with the rearing and discipline of offspring; those which are involved in proper social or political relations and leisure time activities; those which tend to gratify tastes or feelings." 23

The aims for science education for the child today are similar to these same goals which Spencer gave to education, as follows:

> "1. To cultivate scientific attitudes and methods of procedure.
> 2. To lead to broader concepts, generalizations, and outlooks.
> 3. To open new avenues of interest and satisfaction.
> 4. To enable the individual to meet the problems of existence with the available scientific knowledge and requisite skills.
> 5. To develop social attitudes and appreciations." 24

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23. Hunter, Op. Cit. p. 17.
24. W. C. Craxton, Science In The Elementary School, (New York, McGraw Hill Company, Inc., 1937), p. 38

SECTION III

SCIENCE CURRICULUM FOR THE PUBLIC SCHOOLS AS PROPOSED BY THE STATE OF FLORIDA

Science education should be consistent with the general trends in modern education. Science teaching would be benefited by the use of ideas of philosophers of the past. During the past century actual and radical changes have occurred in theories on teaching science in our educational program. Ideas have changed about subject content, about methods of teaching, and about the part the pupil should play in the teaching of the science program in the elementary school.

In the days past, education was largely theoretical and was not particularly practical. At the present time there is a definite aim to relate matters more closely to life. Whereas formerly, the pupil studied artificial problems, the present day school deals with real life problems. These real life problems are relative not only to the present life of the pupil but they are relative also to life of the pupil when he becomes an adult.

Teacher assertiveness characterized the old school, and pupil assertiveness characterizes the new school. In some schools even today learning and accepting the textbook

or the word of the teacher is the prevailing practice, just as it was universally practiced some decades ago. In modern education it is the conscientious effort of well educated administrators and teachers to guide the development of the child towards attitudes of mental aggressiveness, of originality, and of useful pursuit after knowledge. The day of forcing the intellectual acceptance on the part of the child is past. We not only permit it, but we develop in the child the ability to ask wise questions and to test statements made by himself and other students and to accept or reject knowledge from texts and experiences.

Not so very long ago learning was conceived as a "pouring in" process. A lot of learning is unfortunately still so conceived in many schools even today. This principle of learning places emphasis upon facts or rote memory learning of facts and ideas. Well trained educators of today are not satisfied with having the child memorize facts alone, but they are concerned more with the interpretation of facts.

"General outline of the science program for the fourth, fifth, and sixth grade as proposed by the State of Florida.

1. The Earth as a Part of the Universe
2. The Earth and Its Changing Conditions.
3. Matter and Energy are Subject to Change.
4. Conditions Necessary to Life.
5. Living Things and Their Activities.

6. Man and His Environment." 25

See appendix for specific subject matter by grade, page 63.

25."A Brief Guide To The Teaching of Science in the Secondary Schools", Tallahassee: State Department of Education, Bulletin No. 8, 1948, p. 42 (insert)

SECTION IV

WAYS AND MEANS OF ENRICHING THE PRESENT PROGRAM

The school often becomes a place for a feeling that life is ended until next summer. Especially in the fall of the year, when school opens after a summer of free life with the out of doors, the teacher should make an effort to make the child feel at home inside the classroom. Within the field of natural science, which is being stressed in science education in the elementary school, there can be developed a feeling that there is life at school even richer and fuller than on the outside. The life of the child is closely tied up with his natural environment. During the vacation period the child has been taking fishing trips, hikes, seeing movies, observing nature in the raw, discovering new and strange insects, flowers, plants, trees, fossils, and other forms of life in his natural world. In the classroom the child has to sit all day and read textbooks and attend to his natural bodily needs at certain scheduled times. If he is allowed to share his experiences, hear other's experiences, learn more about these things of nature, bring to the classroom specimens of his collections to be studied as to their importance in the life of man, then he is living a more interesting life in the classroom. Frequently the child has

an excursion on the schoolground or elsewhere to study nature and its wonders. The child enjoys this type of activity, and his reaction to school life is more pleasant and integrated. How this atmosphere can be obtained is primarily the task of the teacher. A great many possibilities underlie the teaching of science.[26] The following are some profitable and workable techniques of approach.

There are ten techniques, or ways of approach, which will aid in bringing the natural life of the child within the classroom. The methods or techniques may be called

> " 'Ten Bridges Between School and Community'. The ten bridges between school and community are Documentary Materials, Audio-Visual Aids, Resource Visitors, Interviews, Field Trips, Surveys, Extended Field Studies, Camping, Service Projects, and Work Experiences." 27

> "Documentary materials is a generic term applied to all written or printed sources of information, but it does not include maps, charts, photographs, or other such visual aids. Among the chief kinds of documentary materials are books, magazines, newspapers, pamphlets, diaries, school and library records, deeds, abstracts, tax receipts, bank statements, and bills of lading. Documentary materials may prove useful, because they will provide interesting teaching material for science; promote development of the scientific attitude in the analysis of community problems, interests, outlooks, and needs; stimulate needed perspective by providing comparable data from communities distant in either space or time or both; and permit intelligent solution of community problems by basing both analysis and policy making upon accurate data objectively gathered." 28

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26. Partridge, J.A. Natural Science Through the Seasons (Toronto: The MacMillan Company of Canada, Ltd., 1948) Introduction pp. XV-XX
27. Olsen, Edward G. School and Community, (New York, Prentice-Hall, Inc. 70 Fifth Ave., New York, 1945), p. 73.
28. Ibid, p. 76.

For every community regardless of the size there are available many kinds of documentary materials whereby school instruction can be made more interesting and more functional. Every teacher can enrich and vitalize his own procedures through appropriate use of available documentary material. The use of documentary materials is closely correlated with other subjects. Reading is a part of science. Techniques and skills in reading may best be taught while the child is seeking to find the answer to some vital question or solve a problem which he himself desires to have worked out. Functional English needs may be discovered while discussion periods in science are being conducted. Many of the community problems related to science are also the same as those which are discovered of a social significance to the community. Spelling of scientific words is a part of the science teaching program. Arithmetic is also used in performing the experiments which is a necessary part of the science studies. A list of available material which is useful in the teaching of science in the fourth, fifth, and sixth grades of the elementary school may be found in the Appendix, page 63.

Audio Visual Aids

The utilization of audio-visual aids is not an entirely

new practice. School authorities have recognized the value of these for many years, and simple aids have been used by teachers here and there, with varying degrees of success. The application of modern techniques is new, however, and requires specialized training of teachers so that they understand and are skilled in the use of the intricate mechanical equipment. Many of the machines are so expensive that special budgetry allowance must be made if their use is to become widespread.

Technically, the term audio-visual aid refers to any special device that helps learners to gain a clearer understanding of or a better appreciation of learning content and skills. A list of such aids would include special pictures; drawings, diagrams, or cartoons; maps; slides; phonograph records; silent or sound motion pictures; and radio or television equipment. Some of these aids are auditory, others are visual, and still others represent a combination of both auditory and visual stimulation.

The functions or values of audio-visual aids are:

"1. To furnish vivid experiences which are the essential basis for intellectual analysis, comparison, and generalization about the world of things and people.

2. To provide a simplified view of complex data, and thereby render complicated physical, social, and aesthetic situations more easily intelligible.

3. To personalize geographically distant scenes and events as they almost literally bring the world into the classroom.

4. To make real the past as they create for the student dramatic and authentic episodes of history.

5. To economize time by presenting a wealth of impressions to the students in a well-organized, concise, and intrinsically interesting manner." 29

In using audio-visual aids in teaching science in the elementary school one must keep in mind two things: "1. Remember that the audio-visual aids are an aid to good teaching and not a substitute for teaching; 2. Be sure that the chosen aid directly contributes in maximum degree to achievement of the exact educational objectives sought." 30

Resource visitors

"Resource visitors means any one who is able to demonstrate special accomplishments or particular abilities which are of interest and value to school pupils, and who are also both able and willing to display, discuss or otherwise present their attainments before a student group. Resource visitors are generally utilized for serious educational purposes rather than for mere entertainment. The values of resource visitors are as follows:

1. Permits vital and realistic experiences when excursions are not feasible because of distance, cost, transportation, hazards involved, size of class, school regulations, or refusal of factories, laboratories, agencies, and the like to admit visitors.

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29. Ibid, p. 101
30. Ibid, p. 102

2. Creates better understanding of many different types of people and helps students identify themselves with other people and their problems.

3. Helps students realize that people as well as books are desirable sources of information and inspiration.

4. Promotes social experiences shared by youth and adults to their mutual interest and satisfaction, thereby increasing the respect of each age group for the other.

5. Provides opportunity for developing social skills in real life situations -- letter writing, telephoning, making introductions, receiving guests, carrying on a conversation, interviewing, listening attentively, and leading discussions.

6. Allows adults to learn, through their experience, what modern teachers are trying to do for their students." 31

Interviews

" 'Interviews' are informal personal conferences wherein one or more students question an adult to get authoritative opinion or information of some sort. As a method of community study, the interview technique is similar to that of using resource people. Two points are to be remembered: a. The interview is held in the expert's usual place of work or residence, rather than in the school classroom; b. The interview is primarily a question-and-answer procedure; it does not require of the interviewee a prepared talk, demonstration, or other type of organized program.

The advantages of interviews are:

1. Gives student a personalized view of community living and of some of the values and ends toward which selected residents would direct it. Through their eyes, and in man-to-man intimacy, young people may see community processes in operation; with these adults they may assess human relations.

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31. Ibid, pp. 128-129

2. Provide experiences in meeting people, which is itself an important social quality. The adolescent who has talked successfully with a mature person about matters of common concern has himself advanced toward maturity." 32

Field Trips

Field Trips are any

"organized excursions which are taken by school pupils as an integral part of their academic work, and primarily for educational purposes. Although they have many nonacademic values, their major purpose is instructional, and as such, they are not to be identified with school trips taken to participate in athletic, musical or forensic contests, with hikes or picnics organized for pleasure purposes, or with sightseeing journeys taken by graduating classes.

The advantages of field trips are:

1. Facilitate opportunity for personal experiences which are real, concrete, dramatic, and highly educative.

2. Provide sensory perceptions which cannot otherwise be experienced -- the taste of fresh milk, the odor of wild flowers, the roar of machinery, the heat of a steel mill, and the sight of real things in the real world of pupils.

3. Deepen insight into even familiar phenomena in the environment, for as these matters are freshly interpreted, they take on new meaning.

4. Motivate school work by utilizing natural curiosity, and thus make possible those deep satisfactions which arise out of personal exploration and discovery.

5. Arouse pupil interest in new areas of thought and activity, thereby often leading to further individual reading and field explorations outside of school hours.

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32. Ibid., p. 138-139

6. Integrate classroom instruction by exposing conventional subject matter divisions as artificial, and by enabling pupils to view facts and forces as they exist in their everyday relationships.

7. Enrich the instructional process for both pupils and teacher, since the very activity of jointly planning, executing, and evaluating an excursion provides a common experience of considerable educational significance.

8. Builds character through the practical necessity of developing such traits as courtesy, patience, sportsmanship, cooperativeness, etc." 33

Surveys

Surveys are

"accurate determinations, through organized study, of social or physical data, particularly with reference to its spatial patterning and casual relationships. Surveys should include the recording of discovered data upon some form of spot or base map.

The advantages of surveys are:

1. They foster comprehensive understanding of community structure and processes in their everyday operation, interaction, and complexity.

2. They stimulate depth of insight into vital community problems and trends as these have been influenced by past conditions, present developments, and future prospects.

3. They disclose problems which should be met -- not only because teacher or textbook loftily says so, but because the evidence itself inescapably reveals the needs.

4. They suggest possibilities for student participation in the ongoing processes of the community.

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33. Ibid., p. 148-149

Such constructive participation, cooperatively carried on, provides fine personal satisfactions, as well as essential training in democratic citizenship.

5. They develop awareness of human interdependence and of the practical necessity for general civic cooperation in carrying on successful individual and group living.

6. They promote superior citizenship by providing extended experience in the making of critical judgments concerning existing conditions. Students learn, through personal actions, to base conclusions and recommendations upon factual data carefully assembled, objectively interpreted and meticulously verified." 34

Extended Field Studies

"Extended Field Studies combine the essential elements of a long excursion and a survey; that is, they take the group out of its home environment and into a new one for purposes of serious field analysis over an extended period of time. Such a field study may last from several days to several months; its geographical area may be local, regional, national, or even international community; it may be confined to one small community, or it may require travel over thousands of miles. Yet the members of the group engaged in extended field study always work, learn, and live together during the course of the project.

Although educational field study may properly include opportunity to 'see the sights', it should never be confused with mere sight-seeing. Whereas genuine field study measures up to academic standards in the definition of its subject matter and the rigor of its methods, the sight-seeing trip rushes from place to place, its members absorbing sensory impressions, largely devoid of intellectual or emotional substance. Too often the purely sight-seeing trip masquerades as education, and too often teachers are accessory to that deception.

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34. Ibid., p. 171

The values of extended field studies are:

1. To stimulate imagination and learning interests as they introduce us to new and different environments.

2. To expand horizons by making us acquainted with people whose manners, customs, living standards, outlooks, and interests may be quite different from our own.

3. To facilitate objectively in studying controversial issues. The tax-supported public schools, and even the parent supported private schools, have to approach many local situations with caution. Often the most accurate problems cannot be touched because of the adult emotions involved. But these very problems may often be studied with complete candor in another community removed from one's own.

4. To provide perspective upon the home situation. No one really knows his own environment and his own neighbors until he has compared them with something different.

5. To teach the art of living with others. The day-in-and-day-out association -- traveling in the same conveyances, sharing rooms, sitting at the same table, participating in the same experiences, getting deadly tired together -- is not without strain and stresses. Idiosyncrasies and character defects come to the surface; so also do traits of nobility. The purpose of the field trip is to focus attention upon the outside world, but in the business of living and working intensively with others, the student also gets under his own social microscope.

6. To treat pupils and teacher as complete personalities. The teacher is no longer merely an instructor; he is now also parent, companion and arbiter. Pupils are no longer detached from their background; it is now as though they have moved into the classroom, bag and baggage." 35

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35. Ibid., 198-199

School Camping

"School Camping is defined as group living close to nature. It denotes an informal yet organized rural living experience particularly designed for city youth. It was the growth of great cities, separating the urban children from the elementary forces of humanity which forced educators to find in creative outdoor camping another vital bridge to link city school instruction with country community living. Meanwhile rural camping developed also, particularly among boy and girl scouts and members of 4-H Clubs, Future Farmers of America, and similar organizations.

The values of School Camping are:

1. To provide sustained experiences in democratic living and community service. The exigencies as well as the programs of organized camping require that each camper live and work as a participating member of a democratic social group. As such, he must respect the origins, actions, and opinions of his fellows. He must share with them in responsibility deciding group policy and in executing the chosen course of action. He has every chance and stimulus to exercise personal leadership, loyal fellowship, initiative, self-control, and good sportsmanship.

2. To foster intimate appreciation of nature. Daily living close to nature brings a close personal awareness of soil and stream, cloud, and rock, sunrise and evening star which may immeasurably enrich one's intellectual and spiritual life.

3. To promote health through developing outdoor interests. Physical vitality, pulsating energy, and radiant good health all demand regular outdoor physical activity. Camping brings a depth of personal satisfaction with outdoor activity, and a deepened appreciation of physical fitness." 36

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36. Ibid., pp. 226-228

Service Projects

"Service Projects are cooperative group activities organized and carried out by pupils as specific contributions to civic welfare. It involves individual activity of an integrated mental-physical-emotional-spiritual nature; service projects eventuate in genuine educational value to the student as well as in significant social value to the community.

The values of Service Projects are:

1. To give hope and courage to youth who are in danger of demoralizing frustration. They promote change from despair at the thought of a 'world like a hog trough already too full of feet', to an eager desire to help build for all men, that king of truly civilized community which this earth could become.

2. To effect definite social improvements and thereby enable youth to contribute in significant fashion to the social progress of his group.

3. To promote status for youth by enabling adults of the community to understand and approve the contributions being made by youth to the common civic welfare. Such social recognition is deeply prized, for it is among the most desired of all achievements during the adolescent period.

4. To create more functional patterns of education. Each century, each generation, we have outgrown our previously prevailing notions about formal education. Just as our scientific researches into the psychology of the learning process moved us, during the 1920's, from support of the traditional school to that of the activity school, so our scientific insights into the sociological nature of human relationships are now drawing us forward to uphold the community, life-centered school.

5. To stimulate all-around growth and development of the students, since the projects undertaken are of such nature as to necessitate sustained and integrated effort of intellect, emotions, and physique.

6. To help to make world citizens out of provincial youngsters because they lift the imagination from petty matters of the moment to the enduring life concerns of all peoples everywhere." 37

Work Experience

" 'Work Experience' is sustained and interrelated activity of body and mind, carried on for the purposes which are primarily prevocational in nature. This activity for the elementary school child is carried on in home duties, errands, helping neighbors, clerking in the store at Christmas time, making gifts for Christmas and other similar ways.

The values of Work Experiences are:

1. To work activities at home. Many students are forced to work within the home, on the farm, in the family store, etc. Such 'work experience' is important, but is not likely to develop fullest educative value for the adolescent unless it is carried on with personal interest and insight. The school's responsibility is to stimulate that insight and interest by continuous official recognition of the student's work at home, and of its genuine significance to him, his home, and to society in general.

2. Part-time jobs. Enterprising young people always find remunerative minor jobs for themselves -- selling newspapers, shining shoes, delivering groceries, picking fruit, caring for children, Saturday clerking in stores, and the like. Such 'normal' work experience by children was enormously extended during the manpower shortage occasioned by the war, when scores of thousands of boys and girls secured part-time and summer situations in industry, agriculture, and business. These war jobs usually carried adult status with adult pay. Paid work experience of all these varieties is tremendously valuable to youth, providing always that they labor in jobs which permit growth in initiative, responsibility, and skills, and also that they are not physically, financially, or morally exploited in the process.

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37. Ibid., p. 250-251

3. Group service-work projects. Here and there is a local community which has so fully integrated the school program with the life of the community, the service project with the work experience, as to make the two approaches almost indistinguishable.

4. Individual vocational training. Sometimes systematic and specific occupational training is given by community industries and offices working in close cooperation with the school's vocational education program. In the Jacksonville plan, students study part time, work part time, and are supervised throughout by officials representing industry and labor as well as the school. On the college level, cooperative work-and-study plans are well exemplified by the 'Antioch Plan', whereby students alternate periods of work off campus with periods of study on campus. Yet regardless of the specific administrative plan, this type of work experience stresses the integration of vocational and social thinking with vocational skills as a fundamental, shared responsibility of school and community." 38

Making Use of Scientific Community Knowledge. The study of local community resources is also a means of enriching the science curriculum. In considering the problems of a community, it is important that the elementary school teacher develop a perspective of the relationship of the community to her task of teaching children. Her first responsibility is to the children in her classroom. A knowledge of the community helps her to a better understanding of these children and their needs and will serve to enrich her instruction.

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38. Ibid., pp. 273-274

As rich as a community may be for study, it should never be utilized as a curriculum in itself. The community is best understood in terms of the fundamental natural and social forces which have operated to make it what it is. Furthermore a local community is but a minute portion of a larger world community. The local community is subject to disturbances which come from outside, such as the hurricane, the flood, the polar front, the economic depression, the causes of war, the spread of contagious disease, the migration of peoples.

> "The teacher need not pose as an expert in any one of the fields presented by problems of the community. For the most part these problems are intricate and the best recommendations for their solution come from men who are duly qualified to be authorities in the fields represented. The teacher's task is to draw the information from reliable sources and to guide the children toward a realization of the importance of utilizing authentic sources. The teacher, then, is a connecting link between the scientific agencies of the community, state and nation and the children in her classroom. As such, the teacher will need to be alert so that she may detect the difference between propaganda and reliable scientific information, for we live in a period in which propaganda is given the artificial appearance of scientific fact. The teacher can learn science with the children; she can also study community problems with the people of the community. The material which follows is to be considered suggestive of some of the ways in which a teacher or group of teachers may undertake the study of a community." 39

In order to be a better science teacher one must become

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39. Craig, Science in Childhood Education, (New York: Bureau of Publications - Teachers College, Columbia University, 1944), pp. 55-57

acquainted with the natural resources of the local community and of communities further away. It is these sources in which children are naturally interested. The following is a list of community interests which was prepared by the State Department of Education, Tallahassee, Florida:

1. Beach Erosion
2. Soil Erosion and Leaching
3. Florida Winter Season
4. Solar Water Heater
5. Florida Caverns
6. Watermelons
7. Brahman cattle
8. Pastures
9. Ramie
10. Frog Farming
11. Spanish Moss
12. Citrus Industry
13. Timbering
14. Florida Parks and Forests
15. Airplanes (aviation)
16. Florida Strawberries
17. Tupelo Honey
18. Tung Oil
19. Peanuts
20. The Canning Industry
21. Sweet Potato
22. Tobacco Growing
23. Fishing Industry
24. Florida Sunsets
25. Minerals of Florida
26. Florida Pulp and Paper Industry
27. The Gulf Stream
28. Florida as a Poultry State
29. Florida Birds
30. Naval Stores
31. School Garden

A discussion of these may be found in the appendix, page 81.

Devising a List of Inexpensive Equipment. Collecting

of equipment should be a cooperative undertaking of the teacher and the pupils. Construction of some simple apparatus may be done by the pupils. Care of equipment is important, as it will become damaged or misplaced unless properly used or stored. Every piece of equipment should have a place in which to be kept when not in use. All equipment should be kept in containers - labeled boxes or labeled shelves. It is quite feasible to segregate a corner of the elementary school classroom for science activities which will help to preserve science equipment.

There are many items of equipment which cost very little and can be secured easily. The Five and Ten Cent Stores carry a long list of important and worthwhile paraphernalia helpful in performing experiments. Some things needful for better science learning and teaching may be bought from the grocery stores. The child can bring various items from his home, such as a potato, salt, seeds, plants, pets, a hammer, nails and a saw.

Some things not to be found in these places may be collected from the drug stores, and supply companies. A list of the items which have been found of vital importance in elementary science programs may be found in the Appendix, page 93.

Method of Instruction.

1. A review of effective methods, procedures, and techniques of enriching science in the elementary school.

a. Methods.

(1) Traditional Method. This method consists of teaching the child or group of pupils by having them memorize facts. No consideration is given to individual differences. The pupils do not perform experiments to correlate with the textbook subject matter. Little emphasis is placed on correlating this type of science study with other related subjects in the curriculum. This traditional method is becoming obsolete.

(2) The Unit Method. A unit consists of purposeful (to the learner), related activities so developed as to give insight into, and increase control of, some significant aspects of the environment; and to provide opportunities for socialization of pupils. There is no agreement as to the length, content, procedure, or method of termination. There are no restrictions on subject matter, and many subjects may be involved. There is no implication that subject matter is ignored. There is a definite implication that learning and socialization should be simultaneous.

According to Caswell and Campbell, units consist of the following subdivisions:

" (a) Subject matter
1. Topical unit.
2. Generalization unit.
3. Unit based on significant aspect of environment or culture.

(b) Experience.
1. Unit based on center of interest.
2. Unit based on pupil purpose.
3. Unit based on pupil need.

For a unit to be desirable it should have certain characteristics. Some desirable characteristics of a unit are listed as follows:

1. A unit should provide continuity in the development of the child.

2. It should contribute to the total development of the child.

3. It should provide for a variety of activities or experiences for the class and for individual children.

4. It should deal with some phase or problem of living sufficiently significant to merit careful study.

5. It should deal with material within the comprehension of the child.

6. It must be challenging to the child.

7. The data gathered and the activities including construction should be as authentic as possible." 40

b. Procedures.

Various procedures are used in teaching science in the elementary school. Some of the present procedures used are:

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40. Lee, J. Murray and Doris, May, The Child and His Curriculum, (New York: D. Appleton Century Co., 1940) pp. 192-201.

1. Documentary materials.
2. Audio-visual aids.
3. Field trips.
4. Resource visitors,
5. Interviews.
6. Surveys.
7. Extended field studies.
8. Camping.
9. Service projects.
10. Work experiences.

c. Techniques.

The techniques are artistic manners in which science teaching is done. Some techniques most commonly used today in teaching science are:

1. Readings.
2. Oral reports.
3. Discussions.
4. Experiments.
5. Evaluations.
6. Writings.
7. Drawings.
8. Spelling.
9. Following directions.
10. Personal conferences.
11. Audio-visual aids.
12. Demonstrations.
13. Exhibits.
14. Pageants.
15. Plays.
16. Story telling.

SECTION V

FINDINGS, RECOMMENDATIONS, AND NEED FOR FURTHER STUDY

Findings.

In making a study of the elementary science program, the following findings are noted:

1. An increasing amount of science teaching is being done in the elementary school.

2. Careful planning is necessary for adequate teaching of science in the elementary school.

3. The pupil is naturally interested in science.

4. Many community resources are being used in teaching science in the elementary school.

5. Science teaching in the elementary school is a basic part of the school curriculum.

Recommendations.

1. More science training should be required for teachers of the elementary school to achieve maximum results in teaching.

2. More and better equipment should be supplied at public expense for science teaching in the elemtnary school.

3. Teachers should be more adequately trained for the wise use of audio-visual aids used in science teaching.

4. Science supervisors should be appointed in each county to aid and guide teachers in teaching science in the elementary school.

5. A more intensive study of community resources should be made for teaching science in the elementary school.

6. The parents of the community should take a greater interest in the scientific work being done at the school.

Needs for further study.

To promote a richer science program, there are additional contributions which should be made to the science curriculum as follows:

1. A more complete survey of local community problems should be made.

2. A comprehensive evaluation of the science curriculum in order to determine necessary adjustments should be afforded. More remote effects of science teaching are not known.

3. A study needs to be made to determine how more cooperation between the community and the school can be obtained in the effective teaching science.

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A P P E N D I X

APPENDIX

A. Criteria For Evaluating The Elementary Science Curriculum

Evaluation of the elementary science work should be a continuous process with two basic questions always in mind. (1) How are we doing now in teaching elementary science and, (2) How might we do better in the future? In making such an evaluation four basic steps may be followed:

"1. Determine definite goals for achievement. Decide exactly what you want to accomplish--what specific understandings, attitudes, and skills you wish to achieve through the project at hand.

2. Collect evidence of achievement. Assemble all possible data indicating relative success and failure in achieving the goals as defined.

3. Decide upon degree of present success. Formulate conclusions, based upon evidence, concerning the extent to which sought goals are actually being realized.

4. Draw inferences for future policy. Recognize the implications of present success or failure for future activity; describe those implications in terms of adjusted or expanded purposes; and proceed in a constructive manner. Evaluation continues as long as the project lasts." 41

In evaluating the science program, it is necessary that the pupil be considered for two reasons:

1. To determine the immediate effects of science training on the pupil.

2. To determine the future effects of science training on the pupil.

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41. Olsen, Edward G., School and Community, (New York: Prentice-Hall, Inc., 1945), p. 318.

The following is a list of immediate effects which science training should have upon the child:

"1. The pupil should know the content material and basic generalizations suggested in the text (content material should be of local, state, or national interest)." 42

2. The interest of the pupil should have been increased.

3. The pupil should have a greater appreciation for science such as beauty, usefulness, etc.

"4. A pupil should have acquired certain scientific skills so as to be able to interview successfully an adult who is well informed about the certain phase of scientific processes studied." 43

5. The scientific study should have caused the student to acquire desirable and well established health habits.

6. The student should be able to apply scientific generalizations to immediate situations thereby exercising critical thinking.

7. The student should have a wholesome attitude toward scientific work.

8. A pupil should show growth in personal-social relationships. A student should develop a feeling of belong-

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42. Ibid., p. 320
43. Loc. cit.

ing to the scientific group and of desiring to contribute his utmost to scientific group projects.

"9. A Pupil should become increasingly aware of the interrelation between scientific processes and social welfare.

10. The pupil should acquire the philosophy of valuing physical health as a prerequisite to other values in human living." [44]

11. There should be a closer understanding between pupil and teacher.

12. Scientific reasoning should be done by pupil in answering questions.

The following are a list of future effects which science training should have upon the child:

1. The pupil should maintain interest in the scientific work to the extent that he seeks to read and experiment on the scientific work studied.

2. The pupil should retain certain definite skills which may be shown in future demonstrations.

3. The pupil should use in his everyday living the scientific knowledge learned.

4. The pupil should continue to desire to socially share his scientific experiences.

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44. Ibid., p. 321

5. The pupil should know that answers are obtained by scientific reasoning and not by merely guessing.

6. The pupil should be able to continue to show critical thinking in his reading and work.

7. The pupil should continue to gain more confidence in the use of scientific materials.

In an evaluation of the elementary science curriculum, the following points should be considered:

1. Has evaluation been a continuous part of the scientific study or project?

2. Has the scientific project met the basic scientific objectives of the curriculum?

3.Has a complete comprehensive evaluation of the scientific project been made?

4. Has the evaluation made use of varied techniques of appraisal and utilized many sources of data?

5. Has evaluation emphasized self-appraisal, both group and individual?

B. Proposed Science Subject Matter For Fourth, Fifth and Sixth Grades

"I. The Earth as a Part of the Universe.

Grade IV.

A. The Moon our Nearest Sky Neighbor.

1. The moon is solid like the earth.
2. The moon gives reflected light from the sun.
3. There is no life (as we know it) on the moon.
4. We see only the part of the moon that is lighted by the sun.
5. Earth and moon shadows cause eclipses.
6. The pull of the sun and moon on the earth causes tides.

Grade V.

B. The Solar System.

1. The earth is a member of the solar system.
2. The earth is one of the nine known planets that revolve around the sun.
3. The solar system includes different kinds of heavenly bodies.

Grade VI.

C. Sky Wonders.

1. Our sun is one of many, many suns or stars.
2. The sun is a medium sized star, although much larger than the earth.
3. Groups of stars that make imaginary pictures are called constellations.
4. There are different kinds of heavenly bodies.
5. Astronomical instruments are necessary for accurate and scientific study of the sky.

II. The Earth and Its Changing Conditions.

Grade IV.

A. Plants and animals of the past.

1. Plants and animals have lived on the earth a long time.
2. Plants and animals of the past have left their records.
3. Plants and animals of today are different from those of long ago.
4. Some plants and animals of today are in danger of becoming extinct.

Grade V.

B. Time and seasons.

1. Animals and plants react to seasonal changes in various ways.
2. Seasons are caused by movements of the earth in its orbit around the sun.
3. It is colder in winter than in summer because the sun's rays strike our part of the earth less directly.
4. The motions of the earth are a basis for our measure of time.

Grade VI.

C. Weather and time.

1. Weather depends upon many factors.
2. Weather and climate are constantly changing.
3. Weather may be predicted.
4. Seasonal changes may affect plants and animals.
5. Weather conditions affect plants and animals.

III. Matter and Energy Are Subject To Change.

Grade IV.

A. Electricity.

1. We can get electricity by several ways.
2. Rubbing together of certain substances may cause frictional or static electricity.
3. Useful electricity comes from generators or batteries.
4. Some substances are better conductors of electricity than others.

5. Lightning is a form of electricity.

B. Light.

1. Many objects give off light directly.
2. Some objects reflect light.
3. Some substances absorb light.
4. Light rays may be bent in passing from one substance to another.

Grade V.

C. Changes around us.

1. Changes both physical and chemical occur in many substances.
2. All substances are in the form of a liquid, solid or a gas.
3. There are many kinds of rocks.

D. Air.

1. Layers of air around the earth.
2. Air is made up of gases.
3. Air supports combustion.
4. Air exerts pressure.
5. Clean air is necessary to health.
6. Objects which are lighter than air will float in air.
7. Some machines which are heavier than air can fly in air.

Grade VI.

E. Electricity and its uses.

1. An electric current is necessary to produce an electromagnet.
2. Electricity may be used to produce heat and light.
3. Electricity helps us send messages.

F. Sound.

1. Vibrating objects produce sound.
2. Sound differs in loudness, pitch, and quality.

3. Sound travels in all directions.
4. Sound travels through some substances better than others.
5. The air is adapted to hear many sounds.

IV. Conditions necessary to life.

Grade IV

A. Adaptation survival.

1. Living in groups is sometimes necessary for survival.
2. Plants and animals of the past were adapted to the life conditions of their time. When life conditions changed, many animals could not adapt themselves rapidly enough to survive.

Grade V

B. Living things are always changing.

1. Living things pass through different stages of growth.
2. The young resemble their parents yet they are different from them.
3. Plants and animals must be adapted to their environment in order to survive.
4. Both desirable and undesirable qualities may be inherited by offspring.

Grade VI

C. Improvements.

1. Many plants and animals have been domesticated by man.
2. Domesticated animals and plants have different needs from wild life.
3. Some new varieties of plants and animals have been produced.
4. Methods of soil conservation are constantly changing.

V. Living things and their activities.

Grade IV.

A. Struggle for existence.

1. Plants and animals depend on each other.
2. Some plants live in groups and some animals live in communities.
3. Plants and animals reproduce themselves.
4. Some plants and animals are better fitted to live than others which tends to produce a balance in nature.

Grade V.

B. Plant food.

1. Plants get their food in different ways.
2. Green plants make their own food.
3. Non-green plants do not make their own food.
4. A few plants eat animals.

Grade VI.

C. Food for animals.

1. Animals need food for different purposes, such as energy and growth.
2. The structure of animals somewhat determine their activities of obtaining food.
3. Proper food is necessary to health.

VI. Man and his environment.

Grade IV.

A. Plants and Animals

1. Man's protection of plants and animals helps control the balance of nature.
2. Man has improved some plants and animals.
3. Man uses plants and animals to obtain products he needs.
4. Man makes use of the interdependence of plants and animals.

B. Electricity.

1. Man makes useful electricity by batteries and generators.
2. Man uses many means to protect himself from lightning and other static electricity.
3. Current electricity is useful to man because he can control it.

C. Light.

1. Man controls light by using reflectors.
2. Man uses light in seeing an object.
3. Man controls light in homes by lamps.
4. Lenses are used by man to control light.
5. Man has devised many ways of making light.

Grade V.

D. Plants and animals.

1. Man controls the growth of some plants.
2. Man has selected and developed many varieties of plants.
3. Man can control the life or environment of some useful insects.

E. Changes all around us.

1. Man makes useful products from natural formation and deposits.
2. Man made products eventually change back into the natural state.

F. Air.

1. Man controls air pressure to accomplish much work.
2. Man controls the composition, temperature, and movement of the air for comfort (air conditioning, oxygen masks, and fans).
3. Man has made machines for travel in the air.
4. Man has made instruments for testing and exploring the air at high temperatures.

G. Time.

1. Man has made machines to measure time.

2. Man has devised zones to indicate time.
3. The age of the universe is measured in terms of time.

H. Conservation.

1. Man has created parks to preserve the beauties of nature and wild life.
2. Man should conserve human nature.
3. Man has preserved trees and soils through proper treatment and care.

Grade VI.

I. Food for growth and energy.

1. Man attempts a control over his environment to obtain food.
2. Man has learned about body processes that help him use food to his advantage.
3. Man has learned that certain foods are essential to good health.

J. Weather and climate.

1. Man has made instruments for measuring conditions of weather.
2. Man makes use of instruments of communication to assist in making known weather and climate conditions.
3. Man has used currents in the ocean to many advantages.

K. Electricity.

1. Man has made suitable electric circuits for the home and for industry.
2. Man has increasing uses for electricity.

L. Sound.

1. Man controls sound to produce music.
2. Man uses many means for reinforcing sounds.
3. Man controls sound to assist hearing.
4. Man is able to talk long distances because of sound being sent electrically.

M. Keeping fit for work and play.

1. Man can purify water (areation and filtration).
2. Man has learned to control and prevent certain diseases.
3. Man aids health by eating proper kinds and amounts of food.
4. Man has learned that moderate indulgence in all activities of life is a sound principle to follow to insure a longer life.

Scientific concepts appropriate to Grades IV, V, and VI.

1. Changes in weather conditions are due to natural causes.
2. Scientists use instruments in forecasting weather.
3. Our seasons are characterized by weather and climatic changes.
4. Rainbows are due to dispersion of light by water drops in the air.
5. Lightning is the result of unlike electrical charges.
6. Ocean currents affect the weather on Florida's east coast.
7. Lakes in Florida affect the moisture and temperature conditions of the immediate surrounding country.
8. Plants continually give up moisture to the air, and therefore influence weather conditions.
9. Weather conditions at any one time for all of Florida may differ greatly.
10. Cold air is heavier than warm air.
11. The movement of air masses will cause changes in the weather.
12. The acheing of bones and the ring around the moon may accompany weather changes, but are not reliable means of predicting changes in weather." 45

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45. A Brief Guide to the Teaching of Science in the Secondary Schools, (Tallahassee: State Department of Education, Bulletin No. 8, 1948), p. 42 (insert).

C. Professional Literature

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b. Brandley, Franklin, Science Experiments For Ten to Twelve Year Olds.

c. Craig, Gerald S., Science For the Elementary School Teacher, New York: Ginn and Company, 1940, 55 p. $2.90.

d. Craig, Gerald S., Science in Childhood Education, New York: Bureau of Publications, Teachers College, Columbia University, 1944, 86 p. 54¢

e. Croxton, W. C., Science in the Elementary School, New York: McGraw-Hill Book Co., 1937.

f. Forty-Sixth Yearbook of the National Society for the Study of Education, Part 1. Science Education in American Schools, Chicago: University of Chicago Press, 1947. 296 p.

g. Garrison, Charlotte G., Science Experiments for Little Children, Charles Scribner and Sons.

h. Heiss, E. D., Obourn, E.S., Hoffman, C. W., Modern Methods and Materials for Teaching Science, New York: MacMillan, 1940, 351 p., $4.72.

i. Pitluga, George E., Science Excursions Into The Community, New York: Teachers College, Columbia University, 1943, 145 p., $1.58.

j. Preston, Ralph C., Science An Approach In The Elementary School, Philadelphia Public Schools, 1945, 39 p.

k. Science Education for the Elementary Schools of Ohio, The State Department of Education, Columbus Ohio, 1946, 192 p. Curriculum Bulletin No. 3.

l. Science For The Elementary School, State Superintendent of Public Instruction, Raleigh, North Carolina, 1941. 115 p.

m. Science In The Elementary School, California State Department of Education, Sacramento, 1945, 416 p.

n. This Is Science, Bulletin of the Association for Childhood Education. Washington, D.C., 1945, 43 p.

o. Thirty-first Yearbook of the National Society for the Study of Education, Part 1. A Program For Teaching Science. Bloomington, Ill., Public School Publishing Co., 1932, 370 p.

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2. Magazines.

a. Current Science, 40 South Third Street, Columbus, Ohio. 75¢ per copy.

b. Nature Magazine, American Nature Association, 1214 Sixteenth Street, N. W., Washington, D.C. $3.00 per year.

c. Science Education, C. M. Pruitt, Editor, Room 234, Natural History Building, University of Illinois, Urbana, Ill. $2.50 per year.

d. Science News Letter, 2101 Constitution Avenue, Washington, D. C. $5.00 per year.

e. Science Teacher, The National Science Teachers' Association of the United States, North School Street, Normal, Ill. $1.00 per year.

3. Publications Available through State Agencies. State Department of Education.

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b. Pathways In Science, Craig and Baldwin, Ginn and Company, Grades 1-6, 1946.

c. Exploring Our World, Powers, Neuner, and Bruner, Grade 7.

d. Our World Changes, Powers, Neuner, and Bruner, Grade 8.

e. Understanding The Universe, Carrol, John C. Winston Company, Grade 9.

f. Florida, Wealth or Waste? Junior High.

g. A Guide To Improved Practice in Florida Elementary Schools, Bulletin No. 9.

h. A Guide To Teaching in the Primary Grades, Bulletin No. 46.

i. A Guide To Teaching in the Intermediate Grades. Bulletin No. 47

4. Bulletins from Florida Board of Forestry and Park Service (Tallahassee).

a. Arbor Day.

(1) Trees of Florida.
(2) Diagrams.
(3) Pictures.
(4) Descriptive readings

b. Elementary Science Teaching Units.

(1) Grade I The Rabbit.
(2) Grade II The Bob White.
(3) Grade III The Woodpecker.
(4) Grade IV The Honey Bee.
(5) Grade V The Pine Forests.
(6) Grade VI Reproduction of the Pine Tree.

c. Program of Forestry and State Parks.

(1) Free publications from the State Forest and Park Service.

d. Story of the Woods the Farmer Owned.

(1) Leaflets for Elementary School Use.
Second grade and above.

5. Bulletins from the U.S. Department of Agriculture. (Washington).

a. Burning Your Dollars.
(1) Forest fires and measures of prevention.
b. Florida's National Forests.
(1) The out-of-doors as instructional material.
c. Forestry On Private Timberlands.
(1) A record in pictures.
d. Southern Pines Pay.
(1) Good pictures.
e. American Forests.
f. Some Plain Facts About The Forests.
g. Taming Our Forests.
h. Trees for Tomorrow.

6. Bulletins From the Florida Department of Agriculture. (Tallahassee).

(1) After Victory
(2) Agricultural Conservation.
(3) Bullfrog Farming and Frogging.
(4) Florida Crops.
(5) Florida Today and Tomorrow.
(6) Know Your State.
(7) Opportunity In Florida.
(8) Soil of Florida.
(9) Beef Cattle in Florida.
(10) Beekeeping In Florida.
(11) Better Pastures For Florida.
(12) Birds In Florida.
(13) Canning In Florida.
(14) Citrus Industry In Florida.
(15) Commercial Bulb Production In Florida.
(16) Cotton Production In Florida.
(17) Domestic Rabbit Raising In Florida.
(18) Ducks and Geese In Florida.
(19) Fishing In Florida.
(20) Florida Dairying Shows Progress.
(21) Florida's Sugar Bowl.

(22) Flowers For Florida Homes.
(23) Future Possibilities In Florida. Vol. 11.
(24) Growing Asparagus Plumosu In Florida.
(25) Growing New Island Cotton Under Florida Conditions.
(26) Hog Production And Marketing In Florida.
(27) Landscape Plants For Florida Homes.
(28) Marketing Egg And Poultry In Florida.
(29) Phosphate Mining In Florida.
(30) Pineapple Growing In Florida.
(31) Possibilities of The Everglades.
(32) Ramine.
(33) Root Crops Grown In Florida.
(34) Spanish Moss In Florida.
(35) Soil Improving Crops For Florida.
(36) Soils and Fertilizers.
(37) Some Florida Truck Crops.
(38) Strawberry, Blackberry, and Youngberry.
(39) Termites And Other Insect Pests.
(40) Tobacco Growing In Florida.
(41) Tung Oil.
(42) Tupelo Honey.
(43) Watermelons In Florida.

7. Bulletins From The State Board of Health. (Jacksonville).

a. Inexpensive Reading Materials. (The following leaflets may be purchased for 1½¢ each):

(1) How to Make an Insect Collection.
(2) Preserving Zoological Specimens.
(3) Starting and Maintaining a Balanced Fresh-Water Aquarium.
(4) How to Prepare Microscopic Slides of Simple Objects.
(5) The School Terrarium.
(6) Rearing the Silk-Worm Moth.
(7) Feeding Aquarium and Terrarium Animals.
(8) Studying Ants in Observation Nests.
(9) Lantern Slides Any Teacher Can Make.
(10) The Study of Fossil Plants.
(11) The Study of Fossil Animals.
(12) Aquarium Troubles: Their Prevention and Remedies.
(13) Nutrition Experiments.
(14) The Care and Breeding of the Golden Hamster.

b. Library Material for Children.

(1) The School Library.
(2) Extension Library Service.
    (a) Unit Libraries For Children.
    (b) Unit Picture Collections.
    (c) Package Libraries.
    (d) Dramatic Materials." 46

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46. A Guide To Teaching Science In The Elementary School, Tallahassee: State Department of Education, Bulletin No. 7, December, 1947., pp. 71-75

D. Audio Visual Aids

The following list of audio-visual aids are suggestive for science teaching in the elementary school:

"1. Graphic documents are vital.

This includes table charts, organization charts, map charts, pictographs, line graphs, bar graphs, area graphs, physical maps, population maps, historical maps, literary maps, health maps, and relief maps. Such maps and charts would include data on such categories of the community as population, history, geography, political organizations, economic conditions, public welfare, transportation facilities, and artistic heritage.

2. Exhibits as a means of spurring interest.

This includes material objects, specimens, and models to be used to enrich and amplify a study of a community. A few illustrations of examples of such exhibits include anatomical structures, plastics, jewelry, metals, butterflies, seeds, raw materials, plants, coins, furniture, leaves, etc.

3. Pictures showing illumination.

Photographs, sketches, cartoons, paintings, pictures clipped from magazines and newspapers, and many other similar flat pictures provide a wealth of valuable information about a community, whether that community is near or far in either time or space. Such pictures are easily available. Many inexpensive sets and series of prepared instructional pictures are also available from various commercial publishing houses. To gain the most good from pictorial material one must cut the pictures carefully, paste and mount properly, locate artistically, and label correctly.

4. Stereographs.

Not too many stereographs should be shown at one time. More pictures can be shown if the activity is review. In studying new scenes some pertinent questions will stimulate the pupil to study specifi-

cally rather than merely to view generally.

5. Slides and Slidefilms.

Slides and slide films are particularly useful in community centered education. Photographic slides may be classified into two groups: (1) those prepared by local amateurs for the study of immediate community, and (2) those produced by technical experts to reflect the larger regional, national, world areas. Photographic slides may contain community-interest items as old documents, slides from old negatives, and current photographs.

Hand-drawn slides may be used in presenting a wealth of ideas pertaining to the community. Such hand-drawn slides usually consist of etched-glass slides, india ink slides, cellophane slides, and silhouette and paper cutout slides.

The slide film is a 35-mm. continuous film strip carrying a number of photographs called frames or pictures. Slide films have become particularly popular in recent years, and are especially useful for easy amateur recording of field trip scenes, later to be projected in the classroom as part of the trip report. Such slidefilms can be shown with accompanying oral comment, or the spoken explanations, complete with music and other sound effects, may be transcribed upon phonograph records for synchronized use with the projection itself.

6. Motion Pictures.

Through motion pictures, we can almost literally bring the world into the classroom. It is now practically possible to realistically reproduce every form of physical phenomena and life activity by means of motion pictures. Community motion picture films include those of the local community and those of the larger or non-local community. The local community films can be prepared by the pupils of the school, and this affords them excellent technical training which are rich, vital experiences. In making local films, emphasis generally centers about three aspects of the school-community relationship: (1) Interpreting the community to the school students, (2) interpreting

the school program to the community residents, (3) depicting other time periods or important events of the community. The larger community films are usually produced by commercial sources. The essence of such films usually consists of a complete story and a problem. These films nearly always depict true nature.

7. Radio.

All of the major networks and many local stations regularly broadcast programs of a superior educational nature. Besides school instruction the radio is an excellent medium where the pupils can publicize in the community their own findings concerning community life, developments, and problems. Many schools are using local radio stations to acquaint their patrons with the school activities, especially those involving school-community relationships. Such school sponsored programs provide valuable training in the following ways:

a. The fact that the program is to be on the air makes preparation for it more interesting, exciting, and vital.

b. The material must be presented in a competent manner. This calls for effectiveness in every way.

c. Actual experience in a radio program is a memorable personal event, and may lead to further career explorations of the field.

Pupils who attend schools which do not have access to broadcasting stations can use a public address system for presentation of a program to their own class or to the student body.

The programs presented on the radio by larger communities are generally prepared for the public at large or for school instructional purposes. Many men who are still recuperating from injury inflicted during the recent war are receiving educational instruction from the Armed Forces Radio Service.

8. Recordings.

Through the use of phonograph records and transcriptions a community study by the elementary school science class may be immensely enriched. A nice feature of records is that they can be made by elementary science classes. Recordings of local, state, or national events may be made by the pupil and in this way natural and realistic events may be preserved. The United States Office of Education maintains a free loan service whereby hundreds of radio transcriptions may be borrowed by educational agencies without even transportation costs to the user. The Recording Division of the New York University Film Library and the American Council on Education lists 1000 educational recordings, some of which are on science and which may be rented or purchased.

9. Dramatics.

Pageants, plays, and skits may well serve a definite functional purpose in teaching elementary science. They serve especially well to culminate activities for large units of work, and they are excellent media for developing intellectual understandings and emotional attitudes. They also impart information and cultivate attitudes. Full-length plays require more preparation than skits and one act plays and should therefore be presented on important school occasions as part of community festivals.

10. Television.

Television may eventually become one of the greatest audio-visual aids to school instruction. Television may be used to portray laboratory experiments and demonstrations; excursions into industrial plants, museums, art galleries, churches, welfare centers, historic sites, community festivals, engineering projects, cooperative communities, and experimental schools; and important, influential personalities may be seen and heard from television screens." 47

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47. Olsen, School and Community, (New York: Prentice-Hall, Inc. 1945), pp. 98-126.

E. Community Study Outline

"1. Beach Erosion

Beach erosion is an illustration of the fact that earth conditions change gradually. Beach erosion is caused in part by tides, currents and storms. There is a good example of beach erosion in Manatee County, where on Anna Maria Island the beach has noticeably changed, becoming narrower all the time. To the south about 10 miles the beach is becoming larger. A survey has been carried on by the government, and information concerning beach erosion in Florida may be obtained by writing the Office of Geodetic Surveys, Washington, D. C.

2. Soil Erosion and Leaching.

Soil erosion and leaching are examples of running water changing the land. The soils of the hilly sections of central and western Florida counties are subject to severe erosion losses. Soils of other sections suffer severe leaching losses. Such losses lead to reduced yields per acre and poorer quality of product, reduced yields per acre and thus result in lowered incomes and levels of living for the people of the area. Much is being done each year in control measures, such as terracing, planting tree crops, planting and protecting cover crops, filling and repairing gullies, and seeding pasture areas. Some suggested activities for children are:

a. Children look for signs of erosion in school area. Compare eroded area with a forest area.
b. Examine soil in a productive field, noting color, depth of surface, amount of clay in subsoil and hardpan, if any, in the soil.
c. Examine pasture sod and forest area with a spade. Compare the conditions of soil to that of a cultivated field. Which would be most likely to erode?
d. Resod and recondition a small eroded area of school ground or home yard.

3. Florida Winter Season

The basic reason for Florida being a winter tourist

center lies in the fact that the state extends so far south that in the winter time when the direct rays of the sun strike the earth south of the equator, the land still receives more of the direct rays of the sun than do the northern states at the same time. It is easy to show the difference in the heating effects of direct and slanting rays by placing two pans of sand in the morning or afternoon sun, leaving one flat and elevating the other slightly toward the sun. A thermometer thrust into the sand will record the difference in heat.

4. Solar Water Heater.

Solar water heaters, frequently used in homes in southern Florida, are an excellent example of the use of the sun as a source of heat. The device is placed flat against the roof in such a position as to receive the most direct rays of the sun for the longest time. The coil or series of pipes is usually made of copper and is frequently painted black to increase absorption of the sun's rays. These pipes are usually laid on copper plate which is also painted black. The whole device is contained in a flat box-like structure whose double strength, glass lid helps to concentrate the sun's rays. The heated water moves into a storage tank, thus permitting more water to enter the pipes for heating. Even on partially cloudy days a considerable amount of heat reaches the pipes.

5. Florida Caverns.

No school is without opportunity for studying the surface of the earth as an example of changes all around us. Specific features of the neighborhood, such as sand dunes, hills, washes, and caves are all centers of interest around which studies of the earth's surface is a dynamic rather than a static thing, that its form was not fixed in the remote past but is being developed and modified now.

One good example of this type of study is the Florida State Caverns near Marianna. This park is in the limestone region of northwest Florida and holds many attractions with only a few man-made changes. Here may be observed the different kinds

of rocks and their formations, fossils that are the remains of marine animals, and petrified wood. In addition natural rock gardens, wildlife, the nature trail, historical values, and recreational facilities make this one of the South's outstanding state parks.

6. Watermelons.

Plants have to be adapted to their environment in order to survive. For instance, watermelons can be grown commercially in nearly every county in Florida. The planting date has to be varied in different sections, which means that the melons are not all ready for market at the same time. Many varieties of watermelon are grown in the state. The shipment season extends from May to August.

Watermelons are grown best on sandy soil that is well drained, yet retains sufficient moisture to insure growth. As a rule they are not grown on the same land year after year. Rotation should be planned so that watermelons will not be grown on the same land more often than once in seven years.

The most common varieties grown in Florida are Cannon Ball and Garrison. They make melons of good size and appearance and stand shipping to market better than other varieties.

7. Brahman Cattle

Pupils in the central part of the state will be particularly interested in Brahman cattle which are becoming very common. Here is an example of improvement in domesticated animals. In an interview with cattlemen or the county agent, the following information can be obtained:

a. In what ways are Brahman cattle adapted to Florida Climate? (Their ability to withstand drought and heat-sweat glands).

b. Why are Brahman cattle used so extensively to improve Florida's range scrub cattle? (Usually ability to transmit their characteristics to any breed of cattle).

c. How are pastures being improved to care for Brahmans? (New grasses, drainage, chopping).

d. What pests bother the cattle? (Screw worms, ticks, flies).

e. What kind of beef does the Brahman produce?

Further information regarding Brahman cattle may be secured from "The Florida Cattleman", "The Brahman Breeder-Feeder", and from "Beef Cattle in Florida", (Bulletin Number 28) from the State Department of Agriculture.

8. Ramie.

The tall straight stalk of ramie can be used in new and interesting products. It is a perennial and once planted in the proper environment, it will produce a cutting at least every three months for many years. It is a warm weather plant and can be planted only where water control has been provided (canals, farm ditches, etc.). Ramie does well on somewhat acid soils, but the soils should be fertile (highly nitrogenous). These requirements can easily be met in Florida's Everglades where many acres are being planted. The fibers of ramie can be spun, knitted and woven on textile machinery. It is of special importance in making marine cordage because of its resistance to mildew, rot and smoke stack gases, also its high strength when wet and its freedom from shrinkage. It can be used in making fish lines and nets, twine and rope. The strength of the fiber makes it useful in making towels, upholstery, draperies, auto seat covers, and covers for arm rests.

Ramie yields a valuable by-product known as ramie meal which is a high grade cattle and poultry feed, rich in protein and carotene. Carotene is an important source of vitamin A, which promotes the growth of poultry and protects their health. For further information see the Department of Agriculture bulletin, "Ramie".

9. Citrus Industry

Florida has a wide variety of citrus groves. If the children live in an area where the fruit industry is important, an intensive study of the industry locally may be undertaken. Such a study might include not only the scientific information about the raising of fruit trees, and the harvesting of the fruit, but also some consideration of the social and economic problems of distribution and consumption, labor, government control and protection.

Trips to the groves, to the cannery, to the packing sheds, to the refrigerator cars, and so on should be preceded and followed by discussion.

Many aspects of health can be considered in connection with a trip to the fruit groves, especially the importance and the ways of preserving fruit.

The winter conditions may be observed and succession of changes that take place in the groves can be associated with seasonal changes. The fertilizing, spraying, and cultivating all represent examples of applied science. For further information see the Department of Agriculture bulletin, "The Citrus Industry in Florida".

10. Timbering.

There are many science experiences possible in the study of lumbering. This unit might include the study of the variety of trees in a local area -- how they grow, the uses of different kinds, such as trees used for pulpwood, posts, veneer crates, and lumber. The ways trees are cut and sent to sawmills, how machines have changed the methods of finishing and dressing are other possibilities. The new uses found for by-products are full of opportunities for illustrating science principles.

11. Florida Parks and Forests.

Florida's national, state, and county parks and forests which have been set aside to preserve the native life, the beauty and the history of Florida, are accessible to practically every school.

Some well known parks that would be of interest to a group of children to visit are: Everglades National Park, Highland Hammock State Park, Hillsborough River State Park, Gold Head Branch State Park, Myakka River State Park, Florida Caverns State Park, Torreya State Park, and Fort Clinch State Park. These parks not only offer different types of recreation, but make it possible to observe the different types and forms of plant growth, both land and water, native wild-life sanctuaries, old buildings and tropical jungles. For further suggestions see the Department of Education, Florida School Bulletin, March 1947, "Using Out-Of-Door Florida as Instructive Material", and consult the publications of the Florida Forestry and Park Service.

12. Airplanes.

Airplanes are an important part of our environment today. Florida, because of its weather, climate, and topography has more hours of good flying conditions than are usually found elsewhere. Children who live in the vicinity of army air bases or municipal airports know that planes are a fast means of passenger travel, and that they transport mail and other cargo, especially perishables and medicine, to distant parts of the world in a minimum of time. Planes are an interesting example of man's inventive genius, making work easier and making time and distance of less concern than formerly. For further suggestions see the State Department of Education Bulletin No. 51, "Developing Understandings for Living in an Air Age." The major air lines have educational materials available, including posters and other pictorial material helpful in developing science understandings.

13. Florida Strawberries.

The raising of strawberries is an important industry in many localities in Florida. The acreage grown by individual farmers varies, although from two to five acres is a size usually found. Peppers, tomatoes, and corn are commonly planted between the rows of strawberries to secure other returns from the land.

A number of varieties of strawberries can be grown in Florida. They may be grown commercially or for home use in every county. Any good loamy soil with humus that will retain moisture is satisfactory for growing them.

Children in localities where strawberries are raised will have the opportunity to visit a field under cultivation, watch, and perhaps participate in the harvesting and packing of the berries. The study of strawberries may lead to other studies of the blackberry, youngberry, and blueberry industry in Florida. Bulletin Number 13, "Strawberry, Blackberry and the Youngberry", Department of Agriculture, will be helpful in this study. An interesting book for the library table is Strawberry Girl by Lois Lenski.

14. Tupelo Honey.

In west Florida (particularly Gulf County) there are many apiaries where Tupelo honey is produced. Many science learnings may be attained with a class visit to one of these apiaries. As the children begin the study of this topic, there will be many things they will want to know such as: Why is this honey called Tupelo honey? How does the Tupelo plant look? What conditions are necessary for its growth? What advantages does Tupelo honey have over other honey? (never crystalizes). How does man use honey? (Food, curing tobacco, brewing, wine making, vinegar). How do bees make the honey? How is the bee adapted to carry the pollen? The study of Tupelo honey may lead to the study of other kinds of honey produced in Florida and why Florida is peculiarly fitted as a honey producing state. Valuable information for the study is found in "Florida Honey and its Hundred Uses", "Beekeeping in Florida", "Know Your State", and "Tupelo Honey". These bulletins may be obtained free from the Department of Agriculture.

15. Tung Oil.

The tung oil industry is one of Florida's newer economic enterprises. Children's study of this industry is interesting as an example of an importation of an industry from China, and as an evidence of the world drive for national economic independence.

The tung oil industry of Florida is new and so has not grown too extensively. A field study of the tung oil industry, with a visit to a grove and a pressing mill, reveals the many phases of the industry, its relation to economics, international trade, weather and climate, plant cultivation, manufacturing and household use.

Such questions as the following may arise and be answered with a trip to a tung oil grove: What different kinds of tung oil trees are there? What methods are used in their cultivation? What are the effects of climate on tung trees? How are trees selected for new planting? What methods are used for setting up new groves? How and when is the crop harvested? How is the oil extracted? How is the oil refined? What is done with the waste products? For further information see the Department of Agriculture bulletin, "Tung Oil".

16. Peanuts.

Since the peanut is one of the easiest crops to grow in Florida and is one of the most important general farm crops grown in the state, boys and girls will derive great benefit through the scientific study of the growing process, harvesting, and the manufacturing of its many products.

Activities and Experiences:

a. Observing planting, growing, and harvesting of peanuts in local fields.
b. Visiting peanut mills where convenient (Many are found along Alabama and Georgia state lines in North Florida).
c. Making peanut butter as a classroom experience.
d. Reading about the life contribution of George Washington Carver of Tuskegee Institute, Tuskegee, Alabama.

17. The Canning Industry.

The canning industry with its immense annual pack is a good example of man's preservation of food. Through the canning processes, vast quantities of vitamin rich foods have gone from Florida to places all over the world. The commercial canning of citrus fruits in Florida did not succeed until

1920. The Florida industry has steadily grown and keeps modifying its methods in the light of improvements in food processing.

A visit to a nearby canning plant will show children how the fruit is prepared, how the canning is done, and how sanitary rules are carried out. This could lead to a study of social studies by an investigation and study of places where the canned fruit is being shipped.

18. The Sweet Potato.

The development of the sweet potato industry in all its phases; cultivation, processing for food both human and stock, manufacture of starch, plastics, alcohol, and pharmaceuticals, presents a good field for science learning in Florida. The value of the sweet potato and its many products is rapidly being realized in the South. The sweet potato helps provide balance in the diet by supplying carbohydrates and vitamin A. Children may experience many learning situations in connection with sweet potato production and processing. Fields may be visited and the plant studied in its natural surroundings. Digging, loading and processing machines may be observed and dehydration plants may be visited.

19. Tobacco Growing in Florida.

Tobacco is one of the state's leading commodities. In 1896, D. A. Shaw of Quincy, Florida, demonstrated the possibility of improving the quality of tobacco by shading it during growth. The result of this was a greater demand for Florida tobacco and a rapid expansion of the industry. The preparing of the soil, the cultivating, the shading, and the harvesting of the crop affords many leads for study. The many diseases peculiar to tobacco and the tobacco insects and their control make good science study for boys and girls.

20. Fishing Industry.

The numerous social and scientific aspects of the fishing industry provide a variety of topics. Florida has a natural environment for fishing which will furnish many situations for science

learnings. Some of the possibilities in this study concerned with science are the following: local types of fish, how they breathe and eat, hatcheries and their operation, hazards of fishing, ways of preservation. Studies of other water inhabitants such as turtles, oysters, and sponges may be a part of the unit.

21. Florida Sunsets.

The peninsula of Florida has the Atlantic Ocean to the east and the Gulf of Mexico to the west and south. Its red sunsets are enhanced by the cloud formations in the atmosphere. Because Florida is low and flat, this brilliant phenomenon can be seen and enjoyed by people in all parts of the state. Sunlight must penetrate the atmosphere to reach the land. When the sun is overhead, the light does not pass through as much dense atmosphere as it would if the sun were as low as at sunrise and just before sunset. The sun appears larger and a deeper red at sunrise and sunset than at midday. As sunlight passes through the atmosphere, its colors will be dispersed (scattered). The colors of the shorter wave length, as violet and blue will be scattered more than those of longer wave lengths, as yellow, orange, and red. The extent to which the colors of light will be scattered depends upon the amount of substances in the atmosphere (density). At sunset when the light must pass through a thick layer of the most dense atmosphere, the violet and the blue colors of light will be scattered more than the yellow, orange, and red. Thus, the remaining colors of light seem to be yellow to red. Colors of light are visible when they fall on some object. When the sun is below the horizon so that it cannot be seen, the clouds will show the brilliant colors.

In the low flat peninsula of Florida where there is a great amount of moisture and cloud formation in the atmosphere, sunsets will be brilliant.

This phenomenon is applicable to the concepts developed in elementary science classes in all parts of the state. The beautiful sunsets seen by the first grade will add meaning to the concept, the sun gives light; while the second grade pupils

will realize that the sunlight passes through the air that surrounds the earth. The third and fourth grade pupils are using the concepts: the earth spins like a top, and light rays may be bent in passing from one substance to another. The pupils of the fifth grade will be making application of the concept that the sun's rays strike the earth and the sixth grade pupils will understand that the brilliant sunset does not happen each day because of the rapidly changing conditions of weather.

22. Minerals of Florida.

Florida is an important non-metallic mineral producing state. It stands first in the production of phosphate; second in Fuller's earth, a clay used in clarifying mineral and vegetal oil; is a center in production of kaolin used in white ware; is an important producer of limestone, lime, and cement; has sand deposits suitable for the manufacture of brick and tile as well as pottery. Mines and plants connected with these mining industries provide many learning possibilities for Florida boys and girls.

23. Florida's Pulp and Paper Industry.

There are several paper mills already located in Florida. The pulp mills are able to use pines, straight or crooked, fast growing or slow growing, thrifty or stunted, limby or clean-boled, thus utilizing otherwise wasted wood. There are paper mills at Panama City, Port St. Joe, Jacksonville, and Fernandina. Much can be learned in a study of the process of paper-making.

24. The Gulf Stream.

The Gulf Stream is not only an interesting phenomenon of the ocean near the East Coast, but is an asset to Florida. Because of the numerous species of fish to be found in this current, it becomes a paradise for both sport and commercial fishermen, attracting many winter tourists. The stream of deep blue water originates in the Atlantic near the equator and flows northward, then divides with part of it

entering the Gulf of Mexico. It is known as the Gulf Stream when it reenters the Atlantic and moves northward along the east coast. Interesting characteristics of this stream and descriptions of the contrasting life found in it and in the adjoining cooler water of the ocean are attractively illustrated and related in The Gulf Stream by Ruth Brindze.

24. Florida Birds.

In Florida where there is probably a larger number of birds in greater profusion of varieties than anywhere in the United States, a study of birds would be most valuable. Children are interested in birds for their attractive colors, appealing songs, and power to fly. At the same time they realize that Florida's birdlife is economically important, first because the birds destroy insects harmful to agriculture, second, because of the use made of domesticated birds, as chickens, ducks, and geese, and third, because of the part they play in distribution of seeds. For further information see the Department of Agriculture bulletin, "Birds in Florida". 48

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48. A Guide To Teaching Science in the Elementary School, (Bulletin No. 7, Tallahassee: State Department of Education, December, 1947), pp. 26-39.

F. List of Equipment

Most of the following material can be brought in by the pupils. If there are any of these materials which cannot be brought to school by the pupils, they may be purchased from the sources listed.

From: Five and Ten Store or Hardware Store.

" 1. Aquarium with cover.
2. Balloons.
3. Bar magnet.
4. Blocks.
5. Blotters.
6. Bowls.
7. Boxes.
8. Brown paper.
9. Bulbs (narcissus and onion).
10. Candles (small).
11. Cellophane.
12. Chalk.
13. Clay modelling.
14. Compass and ruler.
15. Copper metal 8" x 12".
16. Copper wire #18 insulated.
17. Copper wire #22 insulated.
18. Cord (ball) wrapping.
19. Corks.
20. Dry cells (batteries 3 #6).
21. Door bell (electric).
22. Electric hot plate.
23. Fish for aquarium.
24. Flash light.
25. Flash light batteries.
26. Flash light bulbs.
27. Flower pots.
28. Fruit jars with caps.
29. Garden tools.
30. Hammer.
31. Iron roll 6" x 8" in length.
32. Kettle (tea).
33. Lamp (small electric).
34. Matches (safety).
35. Metal rod (thin).
36. Mirror (hand).
37. Nails.

38. Paring knife or pocket knife.
39. Pans.
40. Paste and glue.
41. Pins.
42. Pint and quart bottles.
43. Plane.
44. Plate.
45. Pot holder.
46. Push button switch (electric).
47. Sand paper.
48. Saucers.
49. Saw.
50. Scissors.
51. Screw driver and screws.
52. Sealing wax.
53. Seeds (corn, beans, etc.).
54. Small Triangle file.
55. Spoons.
56. Square.
57. Steel wool.
58. Switch (electric knife).
59. Tacks.
60. Tape measure.
61. Thermometer.
62. Tinfoil.
63. Tumblers.
64. Wax.

From: Grocery Store.

65. Ammonia (household).
66. Baking soda.
67. Salt.
68. Sugar.
69. Vinegar.

From: Drug Store.

70. Alcohol (denatured).
71. Band aids.
72. Gauze wrappings.
73. Iodine.
74. Peroxide.

From: Miscellaneous

75. Assorted cardboard boxes.
76. Pieces of silk, fur, and wool cloth.
77. Wood blocks.

From: Scientific Supply Company. (Cost is about $25.00).

78. Alcohol burner (glass form).
79. 4 - Beakers Pyrex 400 cc. low form with lip.
80. 1 - Burette clamp to use with ring stand.
81. 1 - Compass (magnet mounted on needle support preferred).
82. 1 - Funnel glass 3" in diameter.
83. 5 - lbs. Glass tubing (6 mm. diameter outside.)
84. 2 - Glass squares 4" x 6".
85. 1 - Globe - Earth.
86. 2 - Hand lenses.
87. 25¢-worth Assorted labels.
88. 2 - Magnifying glasses tripod form, reading glass form.
89. 1 - Map of the world.
90. 1 - Map of North America.
91. 4 - Miniature light bulbs (for battery voltage).
92. 1 - Package of iron filings.
93. 1 - pair bar magnets 6" length.
94. 1 - Prism right angle.
95. 2 - Pyrex flasks 250 cc. Florence flat bottom.
96. 1 - Ring stand with two rings - medium size diameter 3".
97. 1 - lb. Rubber stoppers - assorted.
98. 5 - ft. Rubber tubing to fit 6 mm. glass tubing.
99. ½ - doz. live snails for aquarium.

G. The following are a few of the many scientific supply companies from which scientific equipment may be purchased:

Central Scientific Company
1700 Irving Park, Chicago, Illinois.
220 East 42nd Street, New York, New York.

Chicago Apparatus Company
1735 North Ashland Avenue,
Chicago, Illinois.

General Biological Supply House,
761-763 East 69th Place,
Chicago, Illinois.

Denoyer-Geppert Company,
5253 Ravenwood Avenue,
Chicago, Illinois.

Nutrition Chart Company,
814 Fourth Street,
Menomonie, Wisconsin.

A. J. Nystrom and Company,
3333 Elston Avenue,
Chicago, Illinois.

Rand McNally and Company,
536 South Clark Street,
Chicago, Illinois.

W. M. Welch Manufacturing Company,
1515 Sedgwick Street,
Chicago, Illinois." 49

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49. A Guide To Teaching Science in The Elementary School, Tallahassee: State Department of Education, Bulletin No. 7, December, 1947, pp. 69-70.

H. Record Of Candidate

PERSONAL QUALIFICATIONS

Sladesville Elementary School, Sladesville, Hyde County, North Carolina; Graduate 1924.

Pantego High School, Pantego, Beaufort County, North Carolina; Graduate 1928.

Louisburg Junior College, Franklin, North Carolina; graduate with two year diploma 1930.

Madison College, Rockingham County, Harrisonburg, Virginia; graduate with B.S. Degree in Education 1938.

University of Virginia, Charlottesville, Virginia; post graduate work summer 1939.

Davis and Elkins College, Elkins, West Virginia; post graduate work 1940.

University of West Virginia, Morgantown, West Virginia; post graduate work for renewal of certificate 1941.

Florida Southern College, Lakeland, Florida; post graduate certificate 1948 (qualified to teach elementary grades and history, biology, and English in high school).

DEGREES AND HONORS

B. S. Degree in education, philosophy, and psychology was received from Madison College, Harrisonburg, Virginia,

August 1938. Social studies, English, Biology were main subject matter courses.

Member of Alpha Chi Chapter of Kappa Delta Pi, since August 1939.

PROFESSIONAL EXPERIENCE

A total of fifteen years of experience in the public schools of our nation.

Taught in mission school, Amhurst County, virginia, 1930-32.

Elementary School, Rockbridge County, Virginia, 1932-35.

Elementary School, Augusta County, Virginia, 1937-39.

Elementary School, Page County, Virginia, 1939-40.

Junior High School, Pendleton County, Circleville, West Virginia, 1940-41.

Elementary School, Pendleton County, West Virginia, 1941-42.

Franklin High School, Pendleton County, Franklin, West Virginia, 1942-44.

Webster Avenue Grade School, Polk County, Lakeland, Florida, 1946-1949, 5th grade.